

Interim Contractor Report #6

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**Electron Thermalization in the Solar Wind and Planetary Plasma
Boundaries**

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Approaching the Marginal Stability Limit - Analysis II

After reviewing the kinetic mode properties and testing our simulation codes, we have now entered a new phase that consists of setting up, executing, and analyzing a series of simulations. Some of the problems and challenges that we are facing in this phase originate from scaling the smaller test runs to production sizes. Likewise, the cell sizes and time steps required in the simulations vary based on the solar wind parameters modeled, and require according adjustments. In the simulations, we need to address the wide time scales between the whistler wave period and the typical electron thermalization scales in the solar wind. Furthermore, it is necessary to determine the marginal stability limits as well as the characteristics of the electron distribution function and wave properties at saturation, for a given set of solar wind parameters. The ultimate goal of the current phase is to run a series of simulations with decreasing free energy, which can be evaluated in an asymptotic limit.

A new topic that we are starting to address is the question to what extent the evolution of the whistler and electron heat-flux instabilities require two spatial dimensions. If it turns out that the majority of features are well described in (spatially) 1-D simulations, a much greater effort can be placed in investigating a large parameter space, and running the simulations over larger spatial and temporal scales. If, on the other hand, 2-D effects are important, more effort needs to be placed in trying to understand the interplay of modes and the usage of free energy at different propagation directions.

We are continuing to develop our new graphics interface, using the IDL package, to improve the visualization of our results. These new techniques will allow us, to volume-render 3 dimensional data with access via a convenient graphical user interface. We are also in the process of creating workstation versions of our simulation codes that can run on one of our local, dedicated 600 MHz Alpha stations. Scaling initial tests that we have run on 300MHz Intel-based machines, we predict to be able to achieve speeds comparable to a single-processor CRAY Y-MP. Obviously, running simulations and the visualization locally (vs. on a supercomputer) provides us with much faster turn-around times, one of the major obstacles when using and developing state-of-the-art algorithms.

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13. ABSTRACT The work carried out under this contract attempts a better understanding of whistler wave generation and associated scattering of electrons in the solar wind. This task is accomplished through simulations using a particle-in-cell code and a Vlasov code. In addition, the work is supported by the utilization of a linear kinetic dispersion solver. Previously, we have concentrated on gaining a better understanding of the linear mode properties, and have tested the simulation codes within a known parameter regime. We are now in a new phase in which we implement, execute, and analyze production simulations. This phase is projected to last over several reporting periods, with this being the second cycle. In addition, we have started to research to what extent the evolution of the pertinent instabilities is two-dimensional. We are also continuing our work on the visualization aspects of the simulation results, and on a code version that runs on single-user Alpha-processor based workstations.				
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